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ABSTRACT

This study examined the use of written reflection to investigate student teachers' active instructional knowledge during mathematics mentoring. Participants were 30 preservice teachers in a Science/Math Integration methods course. They participated in Community Mathematics project field experiences, which occurred prior to the full student teaching placement. The project involved weekly mentoring at a local public middle school to help fifth graders develop an appreciation of real mathematics. Student teachers were required to reflect upon their mentoring episodes by completing the After-Mentoring Reflection Form. The form asked about things that went well and things that went differently during the session, how successful students were in completing session objectives, changes they would recommend to improve the session, and what they learned that would impact their future teaching. Most preservice teachers' attitudes and levels of expectations changed with each successive mentoring session. Their statements characterized such issues as instructional preparedness, instructional practice, classroom techniques, student participation, student motivation, and numerous others. The study suggests that the formal reflection form is a useful way to identify prospective teachers' beginning pedagogical and epistemological perceptions. (Contains 13 bibliographic references.) (SM)

Using Written Reflection to Identify Preservice Teachers' Active Instructional Knowledge
during Mathematics Mentoring

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A paper presented at the annual meeting of the MSERA, Little Rock, November, 2001

Using Written Reflection to Identify Preservice Teachers' Active Instructional Knowledge During Mathematics Mentoring.

The purpose of this paper is two fold: 1) to serve as a partial (first year of a two year) report for the Toyota TIME grant organization describing the Community Math project and its first year accomplishments, and 2) bring a concise description of the kinds of instructional learning that prospective teachers develop during a mentoring experience. In addition, prospective teacher's active instructional knowledge as well as pedagogical attitude and belief is recorded and discussed.

What is Community Mathematics?

Preservice teachers and other community volunteers were invited to participate in a weekly mentoring project titled, *Community Mathematics*. Community Mathematics is a two year grant project that allows community volunteers to frequent a local public middle school to assist fifth grade students in developing an appreciation of "real" mathematics and is funded by a Toyota TIME grant. The grant was proposed and received by the fifth grade mathematics teachers at a middle school that serves only fifth and sixth grades.

The goals of the project include: improved student performance, allow students to connect mathematics to their surroundings and to what is happening in their community, concentrate on task-specific mathematics, develop skills in use of technology, and to develop deeper understanding of the creating and use of tables, charts, and graphs. In addition, the project requires students to improve problem-solving skills through the following steps: choose a problem, make a plan, gather data, develop a solution, evaluate the product, and make a presentation.

Students were placed in project teams that decided on a specific topic or problem from the overall theme. The four major themes for the two-year project resulted from a brainstorming activity held by the fifth grade teachers. The teachers considered all topics that seem to be of high interest to fifth graders and decided on the following themes: **sports statistics, banking in our community, consumer economics, and mathematics in local industry**. The overall theme chosen for the second semester of the project and of which this paper is a report was - **Banking in Our Community**. Topics from within the theme included such things as: How to use Credit cards, Teen Spending, Buying a Home, Purchasing an Automobile, Investing in the Stock Market, and Checking Accounts. A lesson plan for each topic was written using the Pathwise Domains (see appendix A).

Mentors advised a team of 4-6 students every Wednesday for a thirty-minute session during the 7-week period. Mentor advisement involved: 1) acting as a sounding board for students to bounce ideas off of, 2) assisting the students in realizing what they have the ability and resources to accomplish, 3) holding students accountable for completing the task, and 4) assisting in project goals involving deeper mathematical understanding and community connections.

Additional foci of this study is to identify, through written reflection, prospective teachers' initial beliefs concerning mentoring mathematics prior to their formal student teaching

experiences. In particular the following questions will be addressed: 1) Does the use of a formal reflection instrument serve as a medium for identifying prospective teacher's beliefs regarding mentoring practices? 2) Can the use of specific ordered questions provide a way to describe and determine the nature, origin, and order of those beliefs that lead to active instructional knowledge? 3) Can the use of reflection inform teacher education programs?

What is Active Instructional Knowledge?

The prospective teacher's basic beliefs and prior knowledge concerning teaching and learning affect active responses to instructional settings. Prior knowledge, according to Cheung (1990), is constructed socially and personally resulting in learning that is guided by prior conceptions negotiated in future learning contexts. In other words, the learning about teaching tends to be first influenced by how the student, in this case, the preservice teacher, has been taught and increases with each new level and learning context. In this case, the written reflections of the preservice teachers' responses to specifically guided questions can and should reveal the knowledge that the inexperienced teacher uses in response to new learning and teaching situations.

The practice of instructional reflection should lead to teachers who are skilled in situational decision making (Cochran-Smith, 1991). Prospective teachers interpret the new environment in terms of their current structures. Perhaps reflection on mentoring experiences can reveal how preservice teachers are making sense of the world of teaching and learning. Research has shown the need for the development of more appropriate educational experiences that bring together the environment to be known and the knower (Beal, 1987; McLaughlin and Talbert, 1993; Diaz, 1989). In short, the instructional knowledge that preservice teachers put into action during initial teaching opportunities and field experiences defines, Active Instructional Knowledge (AIK).

Data Source and Procedure

The data for this research report originated from the written comments collected from 30 college students in a Science/Math Integration methods course at Harding University. The data pool consisted of 26 prospective teachers that were also taking the pre-student teaching courses that involved additional field experiences each week and 4 students who were not enrolled in the pre-student teaching experience. The principle researcher for the use and interpretation of the AMR was the professor of the course and a 5th grade math teacher served as the project/grant writer and director on the school site.

Pre-Service Teachers and Community Mathematics

The pre-service teacher performance in the project is considered a partial fulfillment of field experiences, which are required for the math integration portion of the college course: ELED 408, *Integrating Elementary School Mathematics and Science*. The Community Math project field experiences for the novice teacher take place the semester before the full-student teaching placement. In addition, the science methods course, Biology 408, *Science in the Elementary School* is taken in conjunction with the ELED 408, which provides a two-hour block of course time on Mondays and Wednesdays. The block of time allows for approximately 50

minutes of class before each Wednesday's mentoring session. The students are required to reflect on their mentoring episode by completing the, After-Mentoring Reflection Form (AMR).

The Instrument Description

The AMR form was adapted from an After-Teaching Reflection form created by Smith, Lambdin, Linquist and Reys in Teaching Elementary Mathematics: A Resource Guide for Field Experiences (2001). The AMR (appendix a) includes the following ordered questions:

1. Describe two things that went well during the session.
2. Describe one thing that went "differently"(better or worse) than you expected.
3. How successful were students in completing the objectives of the session? How do you know? Give examples to support your statement.
4. Describe any changes you would consider if you were to mentor this session again.
5. As a result of mentoring this session what have you learned that would help you in your future teaching?

The written and verbal reflections of the pre-service teachers' experiences provide a means for developing a descriptive measure of what the students find to be the most challenging aspects of teaching 5th grade students in cooperative grouping under grant conditions. Descriptions of the changing nature of prospective teachers' beliefs and attitudes toward mathematics instruction, group work, and teaching in general have emerged revealing their AIK.

Method

Techniques employed in this study focused primarily on qualitative measures. The qualitative forms of data gathering and analysis are consistent with comparable research of reflection notations and experiences. The nature of the mentoring experience was a varied as the number of mentors and the variety of learners and learner expectations. Qualitative measures then seemed to be more appropriate to identify the wide extremes and complexities of prospective teachers' perceptions concerning specific mentoring/instructional situations. Quantitative techniques included simple counting of the numbers of times certain types of statements occurred within each question classification and computing simple percentages for the total of class reflections.

The definitions of terms and conceptions of categories of statements during data analysis were allowed to emerge (Lincoln & Guba, 1985). Initial reading of responses to each question on the AMR allowed for the identification of categories of statements that emerged from each form. The name/label of the category emerged from the student use of specific and recurring vocabulary. Categories were then given labels and consecutive readings of the statements were placed within a respective category. In the case that a statement did not fit into an established category additional or subcategories were established. Every written statement was categorized within each question of the After-Mentoring Reflection form (AMR).

Further identification of the dynamics of the mentoring process emerged that required formal interpretation. The fact that there were 7 consecutive weeks of mentoring allowed for the identification of strands of instructional belief across practice and expectation. The university students were requested to reflect on an AMR form after each session each week. The forms were read an additional time to determine if identifiable strands existed within the single prospective teacher's responses.

Data Analysis

Analysis of the data occurred in two stages. First the AMR forms were grouped according to student name and date of the mentoring session and analyzed in regards to each question of the form. The written reflections were classified systematically by identifying each statement, fitting that statement to a particular subcategory of the categorizing question. In some cases a comment reflected student-success as a major concern (e.g., completion of task, timelines for task, defining the task); in other instances categories reflected teacher-success (e.g., content knowledge, being prepared, time-on-task). In turn, each question of the AMR influenced or possibly limited student thinking and reflection (e.g., emotional belief, classroom techniques, motivational issues, cooperative learning issues). The intent was to find ways to categorize comments that would provide a means by which prospective teacher's perceptions concerning instruction could be recognized and interpreted. Second, analyses included identifying the occurrence of certain strands within reflections and across question categories to determine the existence of consistencies.

Results

The majority of the statements made indicated that the prospective teachers' attitudes and levels of expectation were changing with each successive mentoring session. The teacher statements revealed pedagogical and epistemological belief structures as each session brought new and salient challenges. Comments characterized issues such as instructional preparedness, instructional practice, classroom techniques, student participation, student motivation, and numerous others. Consistent with constructivist theories, the researcher assumed that the prospective teachers' comments were rationally based, that is, they made legitimate attempts to respond to each question on the AMR and respond to the individual mentoring session. The rational ability of the prospective teachers would include a conglomerate of ideas and intelligence about teaching that began with preconceptions about teaching (Clark, 1988; Powell, 1992), beliefs and attitudes (Ball, 1989; McDiarmid, 1990), the role of community in learning (Wilcox, et al, 1991) and the influence of teacher education courses (Shymansky and Kyle, 1992; Enoch and Riggs, 1990). The researcher recognized the obtrusive and influential nature of the questions of the AMR; that is, the questions could purposely focus or funnel student thinking in specific ways.

The power of the AMR allows for a descriptive and perhaps definitive look at their understandings and beliefs about the origin, nature, and limits of the knowledge associated with teaching and learning as well as the act or practice of teaching. Results from two questions from the AMR, Questions #2 and #5, will be discussed first, followed by results from analyzing strands across of consistency within individual student reflections.

Question 2 –

Describe one thing that went “differently”(better or worse) than you expected.

Prospective teachers frequently made statements concerning behavior management, teacher responsibility, the local teacher, technology, cooperative learning, motivation, and mathematical concepts. Of the total 117 statements for question two, 86 (78%) centered on behavior management. 25 of the 91 statements revealed issues concerning lack of student preparedness and the completing of tasks. 16 comments concerning behavior management involved cooperative learning issues of “working” together among themselves and/or with the mentor. 10 comments addressed keeping students focused and on task. In contrast, 16 statements were made that revealed positive behaviors with a tone of surprise and delight toward students’ abilities to do more and know more than they expected. Further reading of the behavior management statements revealed 8 comments concerning the issues of absenteeism, 5 focused on pressure from the time-line of the project influencing behavior, and 6 statements of specific students’ behaviors involving acting out. The following statements are representative of the more common statements made about Behavior Management as a category for Question 2:

Preparedness

- Some group members did not come prepared with even an idea of what they were supposed to do. • They didn’t bring their stuff. AGAIN!
- I didn’t suspect that the students would already start losing their reflection sheets but one already has. • They lost their info.

Working Together

- No matter what I did with the other two students they constantly talked and picked at one another and would not do anything. • I thought the girls would continue to bicker, but they didn’t. They were civil. • My group isn’t motivated and I think that they are under the impression that they are helping me.

On-Off Task

- It was my fault. I forgot one part of the formula we used for the problem. It got us off track a little. And it took me way too long to realize what happened. • Tangents run rampant in our group. I am there to bring the class back into focus, so that is what I do. • How focused they were when they something simple to do w/their hands.

Positive Behaviors

- Unlike other sessions, the students actually seemed more interested in the project. • I didn’t think the kids would know as much as they already did about credit cards. • Everyone was very helpful and interested in what was going on with the group. • I did not expect the children to have so much prior knowledge and ideas. • Brandon did what he said he’d do for today, and wasn’t so withdrawn from the project. • A positive difference

was the person that took some leadership wasn't the person I would have expected to speak up.

Acting Out

- The three boys were ganging up on the fourth boy. (Making fun of him).
- The boys didn't follow my instructions about going to the library.
- Two of the children didn't want to do anything and caused problems for the rest of the group.
- I was suggesting ideas for their presentation. When one of the students corrected my idea. So one of the other students shouted out that the other boy in the group was smarter than the mentor.

In contrast, the prospective teachers made fewer comments about: Teacher Responsibility - 6 (5.1%), the Local Teacher - 5(4.27%), use of Technology - 6 (5%), Motivation - 2 (1.7%), 2 (1.7%) statements were about Time Management, and only 6 comments specifically mentioned Mathematics. Sample statements about these topics are included below:

Local Teacher

- The classroom teacher discourages the students...
- ... and the teacher "took over" for me. It was different, but it was good because she helped a lot.

Technology

- Working with computers! The students didn't know how to find the information on the internet and we wasted 15 minutes.
- Often didn't work and were unreliable. Couldn't print out student work.

Mathematics

- We wasted a lot of time trying to draw the **graph** and the teacher would not let us do it on the computer.
- I expected all the students to understand **percentages**. They did not.
- I didn't expect them to have difficult drawing **lines and spacing** out the numbers.
- The students cannot perform **simple multiplication** problems.
- One student was having some difficulties with **adding and subtracting fractions**. But after a little instruction she seemed to understand the concept.
- Students seem to work the mathematics with **accuracy**, but didn't appear to completely understand **why**.

Question 5-

"As a result of mentoring this session what have you learned that would help you in future teaching?"

The number of written responses resulted in a total of 120 comments for question five. The categories that emerged consisted of 43 (36%) statements that focused on Student Success,

27 (22%) statements regarded having learned something about Classroom Technique/Behavior management, 9 statements specifically mentioned Cooperative Learning Issues, Teacher Preparation/Success totaled 29(24%) statements, and finally 12 statements were related to Motivational Issues. Students' success seemed to have a variety of meanings from what needed to be done in order to bring about student success by the student or by the teacher.

For the prospective teacher, student success referred to teacher ability and responsibility to maintain levels of appropriate student performance in completing the task responsibly. They believed that teachers should help students to visualize desired outcomes and to increase awareness of teacher responsibility to teach children to be responsible. They should help students stay on task by providing intermittent goals or mile-markers to enhance student accountability. Furthermore, it seems prospective teachers recognize that they must constantly remind students of the end product, in this case, the presentation.

More specifically student success centered on ways to visualize one doing a better job of planning and maintaining appropriate levels of student performance. Within these statements over 50% described means by which success is tied to learning to take responsibility for successful learning. Examples of such statements include:

- They are involved and personally part of the project. Think that this is why they are becoming more responsible in the project.
- That we need to spend time talking to our students and "lecture" them sometimes on how they can improve and help them realize that they need to take some things seriously.
- I really need to let responsibility fall on the students. I need to practice the Gradual Release of Responsibility Model more...
- I shouldn't coddle the kids so much. I need to teach them responsibility.
- Stress responsibility from the very beginning of teaching.
- Responsibility is something you have to continually remind/teach students.

10 additional statements were focused on the teacher's responsibility of reminding students to bring materials, being prepared, and how often one must repeat instructions. The following are samples of these statements:

- That in order for things to be completed I have to mention things more than once. Not to assume they will remember.
- Remember that they need to be reminded to bring things to class.
- For students to hear/listen and know what you said you may have to repeat what you said several times.

5 students made 7 statements that revealed beliefs concerning the importance of visualizing and setting goals. The prospective teachers suggested that students in projects need gates or mile-markers to enable students to envision the desired outcomes. The samples listed below express these beliefs:

- In a project like this I would help them at the very very beginning to develop some sort of picture of what they want the finished product to be like.
- I now know that the majority of the time children will not do assignments unless there are consequences involved. Until the children realized that they would look silly presenting their project and not having anything to show they wouldn't work.
- I learned that making the due date KNOWN helps in getting things done.
- Students often times do better with periodical goals during project.
- Have a little hope that students will get their work done when the students really know what they have to do. Because I get stressed out.

Furthermore, student success according to the prospective teacher included the issues of on-off task behaviors. 16 statements were made by 14 students that express notions of task centered-ness that involved students openly discussing their ideas, staying involved with the students, reminding students to stay on task and focus on the task at hand. In addition, prospective teachers learned that they need to accept the students where they are and that hands-on activities can make a difference. The following quotes describe on-off task issues:

- That there are some children you constantly will have to stay on your toes to keep them on-task...
- One thing that would help me teach is that I realized that some students will always have it together and some won't.
- I learned a lot from this group! At first they weren't on task at all but toward the end they were great and did a god job!
- To see what the students do while you talk. ...I was warned about him, but he is fine with me. I think that its just because he needs to keep his hands busy to not go crazy and off task. I need to see what works for them.

Lastly, reflections concerning the category of Student Success that reveal a combination of ideas and possible solutions for challenges in a mentoring session include:

- Children will surprise you when they are looking for a peer leader and who steps up may not be who you expect.
- I have learned that students need to be reminded that it is OK to have a bad idea because it may spark a great idea to be thought up.
- Even though it is a struggle to keep students on task during group work, they really enjoy group work. When students are not staying on task take them aside and ask them why they are having trouble working.

The student mentors wrote 27 expressions about behavior management issues as some thing that would help them in future teaching. The majority of these statements were about establishing rules and procedures early and being the leader. 3 statements simply stated, "Be patient!" while only one revealed an attitude of discipline, "If students don't do outside work, don't allow them too many "second chances" to get the work in." 3 mentors used the term

“control” as a means to maintain behavior. One such statements read, “Try to always have control over your students.” In contrast, one student wrote, “If students are having a difficult time doing their outside work, you’ll just have to accommodate that problem by working on it together, in class.” Finally, one exceptional statement but perhaps seen as a traditional form of handling behavior challenges reads:

- I moved a little boy who was always talked about irrelevant things and I made him sit next to me. I didn’t have any problems this time and that was a good lesson I learned for my future teaching - rearrange the seating when things don’t work.

Prospective teachers also commented on Cooperative Learning as an instructional item that they would use in future teaching. The following statements represent comments regarding cooperative learning:

- Also that the groups should not have all boys and girls but be intermingled.
- I learned through the course of this experience that it is hard to involve all students when using cooperative learning. There will always be one or two to do all the work. I still do not know how to successfully involve all students during the whole process.
- You have to be careful about which students “work” together because some pairs work better than others. Being able to see which is which early depends on knowing your students.
- When forming a group I will not put all friends together.
- Boys are much more difficult to capture their interests and maintain it. Boys must be held accountable for their out of group assignments.

The recognition of teacher preparation as a category for question 5 was determined with 29 statements. Teacher preparation meant that the teacher should know the content, provide for alternate activities if something goes wrong, and all teacher-made or planned instructional experiences should be ability and age appropriate. In addition, several statements revealed and awareness that students are not “blank pages,” but have experiences that can and should be connected to “new” learning. Availability of resources was also an important factor that has a tremendous impact on accomplishing tasks. The following are examples of these statements:

- To review the mathematical procedures before entering into the lesson.
- Have a lot of materials available for the children to use.
- Good planning pays off because when we plan for things we know what we can achieve in the future.
- I know that I would give my students a little bit of background knowledge on the topics before throwing them into a project like this. I believe that they have to have some knowledge to build on.
- It is extremely important to have a plan “B” if something falls through. For example the computers were full so we filed out the book.
- Be ready for anything.

- I learned that it wastes time to not have resources available.
- Some days it's almost impossible to get some kids involved so be prepared with several strategies.

The prospective teachers realized that developing motivational skills is an ongoing task. They saw a need to be positive and fun while delegating more and more responsibility to their students. Facilitating learning is a skill that must be constantly worked on and improved to meet the needs successive mentoring session. Motivational statements included:

- I would give the students some extrinsic motivating factors to Push their want to work every time not just one time.
- You have to be very motivating to get students to be interested in something they aren't getting a grade for.
- Not to give up. The students had not earlier shown interest, but they did today. In future teaching I won't be discouraged just because the students don't show immediate interest.
- I learned that I really need to learn some motivation techniques and the importance of being positive yet firm.

Friday Discussions

In contrast and addition to the written responses on the AMR, opportunities for verbal reflection were provided during question and answer times on Fridays following the mentoring sessions on Wednesdays. The following statements are representative of the type of questions asked during the first open classroom sharing times:

- What do you do when a child will not participate?
- The girls in my group tend to pick at each other. How do you deal with that?
- I just don't have enough time to do anything.
- How can we get anything done in just 30 minutes one day a week?
- How are you going to grade us on this?

Approximately one week from the time for the 5th grade students' presentations, the university students made these comments:

- I just feel like I have failed. My students haven't brought anything they said they would bring.
- Yes, I just don't feel good about what I have done. There just wasn't enough time.
- Am I going to get a grade for this?
- What if they just don't bring anything to present after all of this time?

The students who did not speak up in the open discussion sessions relayed to the researcher that they had a very positive experience and were looking forward to seeing their students make their presentations. In the end all but one student expressed a pride in their groups final performance.

In conclusion, comparison of the percentage and types of categories between the two questions reveals that prospective teachers in the Community Math project did not expect children's behaviors to be an issue. In particular they were somewhat disappointed that students would not come to class prepared and were impressed with how lack of preparation influenced the out comes of each session. 78% of the comments for question 2 were about Behavior Management issues, while only 20% of the comments about what you would use in future teaching were concerned with Behavior Management . The instructional item that the student mentors would most likely us in future teaching tended to be focused on the success of their students, primarily how their own teacher behaviors and decisions could be changed to bring about success.

The consistent strands within and across the individual prospective students' reflections show a clear adjustment from a "blaming" stance for group failure to a personal acceptance of the their own responsibility for the structure of the success of the students. In short, the prospective teachers began to truly see themselves as teachers who must take responsibility for facilitating students' successful learning.

Implications of the Study

The study suggests that the use of a formal reflection form is useful way to identify prospective teachers beginning pedagogical and epistemological perceptions. The underlying assumption of this study is that identifying the "active" beliefs about teaching is one of the first steps in developing field experiences that confront the theory laden beliefs within preservice teachers. Possible implications of the findings are listed below:

- 1) The use of an after mentoring reflection form is an effective way to identify prospective teachers' "working" beliefs about teaching.
- 2) The use of specifically ordered questions allowed for a synopsis of how prospective teachers view the world of teaching in a given mentoring situation. The nature, origin, and order of prospective teacher's knowledge can be identified and tracked throughout a series of teaching episodes or sessions. That the foci of attitude, belief, and resulting practice are often changed and adjusted.
- 3) Consideration of prospective teacher's reflective comments provide an opportunity for teacher educators to take an active role in discerning and influencing pre-service teacher dispositions. More specifically, the teacher educator can target those beliefs – identify detrimental beliefs and emphasize beliefs that are in line with goals and objectives of the teacher education program.

Finally, prospective teachers are often asked to reflect on teaching cases or isolated field experiences that are never read or appreciated by the teacher educator that has made the assignment. In this study a sense of what prospective teachers reflect on during on-going field experiences provides a myriad of findings that can create a deeper and richer understanding of the preservice teacher and better prepare teacher education programs to produce more caring and effective teachers.

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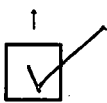
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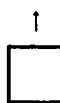
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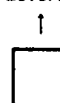
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